UCRL-AR-133354 Rev 1

HEPA Filter and In-place Leak Testing Standard

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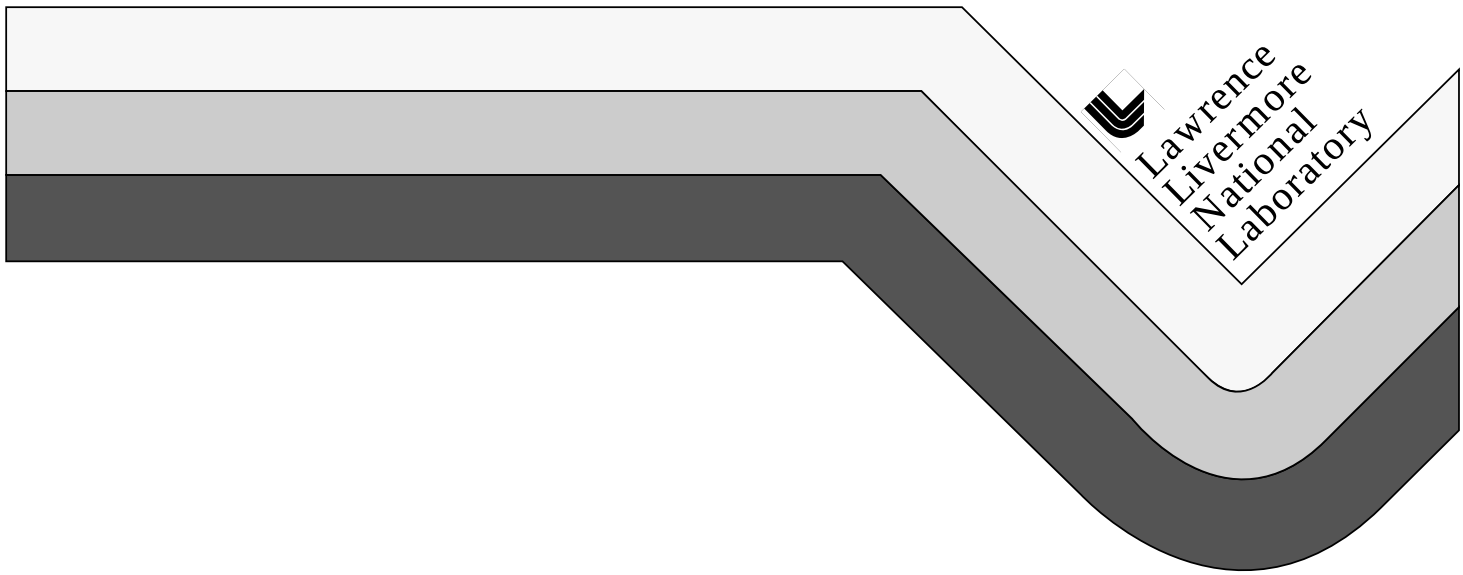

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Preface

The HEPA Filter and In-place Leak Testing Standard is one of several local Lawrence Livermore National Laboratory (LLNL) environmental, safety, and health standards that was prepared during the Work Smart Standards Closure Process to address areas not adequately covered by Department of Energy (DOE) orders or national consensus standards. The original version was reviewed on March 19, 1999 and peer reviewed by May 14, 1999. Questions or comments about this standard should be addressed to the Technical Support and Policy Development Division in the Hazards Control Department.

Lawrence Livermore National Laboratory

HEPA Filter and In-place Leak Testing Standard

1.0 Scope

This local standard establishes LLNL specifications that supplement the national standards (referenced in Section 2.0) for the operation of high-efficiency particulate air (HEPA) filters when installed in ventilation systems used for worker, public, and environmental protection from significant exposure to highly hazardous (e.g., radioactive, carcinogenic, beryllium) aerosols. The supplemental specifications define the maximum pressure drop, maximum age, and in-place leakage that can be allowed before the filters must be replaced. This local standard also identifies procurement specifications for HEPA filters.

1.1 Limitations of this Standard

This local standard and the referenced national standards do not apply to filters installed on glove boxes to prevent contamination of a length of duct separating the glove box and the building's HEPA filters ("housekeeping filters"), HEPA filters in vacuum cleaners, HEPA filters installed in waste containers, or HEPA filters used in clean rooms or laminar flow benches to protect work pieces. HEPA filters in ventilation systems that are not used to protect workers, the public, and the environment from significant exposure to highly hazardous aerosols are exempt from this local standard. This local standard and all the referenced national standards do not apply to HEPA filters that are addressed separately in the LLNL Work Smart Standard Set, (i.e., biological safety cabinets and asbestos abatement).

1.2 Use of this Standard

This local standard and the referenced national standards address in-place leak tests and replacement of HEPA filters installed in ventilation systems designed to remove highly hazardous aerosols from effluent streams. The referenced standards in Section 2.0 shall be used as the primary standards for HEPA filters, including their installation in housings and in-place testing. A risk-based graded approach will be used to determine the priority for replacing existing HEPA filters that are not in compliance with this standard.

2.0 Referenced Documents

- American Society of Mechanical Engineers (ASME), *Nuclear Power Plant Air-Cleaning Units and Components,* "Filter Housing," ASME N509-1989, Section 5.6. This ASME N509 standard applies only to new filter plenums and as a guide to upgrading existing filter plenums. The ASME N509 standard does not apply to side-access filter housings but can be used as a guide for them.
- American Society of Mechanical Engineers (ASME), *Testing of Nuclear Air-Cleaning Systems,* "HEPA Filter Bank In-Place Test," ASME N510-1989, Section 10.
- DOE-STD-3020-97, *Specification for HEPA Filters Used by DOE Contractors.*
- Lawrence Livermore National Laboratory, *HVAC Systems in Nonreactor Nuclear Facilities,* UCRL-AR-133352 Rev 1 (1999). This local standard applies only to LLNL nuclear facilities.
- Lawrency Livermore National Laboratory, *Maximum HEPA-filter Life,* UCRL-AR-134141 (1999).

3.0 Terms and Definitions

Challenge aerosol: An aerosol generated during the test for in-place testing of installed HEPA filter systems. The aerosol is polydisperse with a light-scattering mean droplet diameter of 0.7 μm. The original challenge aerosol used was dioctyl phthalate (DOP); however, other equivalent nontoxic liquids are commonly used. LLNL currently uses poly alpha olefins (PAO).

HEPA filter: High-efficiency particulate air filter**.** A throwaway, pleated, unreinforced media, dry filter with a rigid casing enclosing the full depth of the pleats. The filter has a minimum efficiency of 99.97% when tested with an aerosol of essentially monodispersed 0.3 μm challenge aerosol.

Leakage: Passage of challenge aerosol past the HEPA filter between the upstream and downstream sample ports as defined in the following equation:

$$L = 100(C_d / C_u)$$

Where

L = percent leakage

C_d = downstream concentration of aerosols

C_u = upstream concentration of aerosols

Pressure drop: The differential static pressure across the filter in units of inches, water gage.

Significant exposure: The amount of hazardous aerosols that may subject workers, the public, or the environment to levels above recognized exposure standards, regulatory emission levels, or Laboratory requirements.

4.0 HEPA Filter Operation Specifications

4.1 Pressure Drop Limit

HEPA filters shall be removed from service before the pressure drop across the filter exceeds five inches of water when normalized to the rated airflow of the HEPA filter. To determine the normalized pressure drop, the measured pressure drop must be corrected for deviations from the rated airflow of the HEPA filter as follows:

$$\Delta P_{nor} = \Delta P_{meas} (F_{rated} / F_{meas})$$

Where

ΔP_{nor} = normalized pressure drop

ΔP_{meas} = measured pressure drop

F_{rated} = rated air flow

F_{meas} = measured air flow for HEPA filters

The maximum airflow through the HEPA filter must not exceed its maximum rated flow.

4.2 Age Limit

Currently, there are no regulations or standards concerning the service life of HEPA filters; however, LLNL has set age limits based on the best available information. This standard establishes the requirement that HEPA filters shall be replaced ten years after the date of manufacture. The exceptions to this requirement are as follows:

- Any such filter that has become soaked or which could have become soaked, as from the activation of an in-duct water sprinkler or from spraying water directly on the filter, shall be replaced promptly.
- Any such filter that could become soaked, as from the activation of an in-duct water sprinkler, shall be replaced within five years of the date of manufacture.

If the manufacturing date is not available, HEPA filters shall be replaced after five or ten years, as applicable, from the date of original certification at a DOE filter test facility.

4.3 Acceptance Criteria for In-place Leakage Tests

HEPA filters covered by this local standard are subject to annual in-place leakage tests as prescribed in ASME N510-1989, Section 10. The HEPA filter and its installation are acceptable if the percent leakage is equal to or less than 0.03% or other value less than 0.05% and specified in an approved Technical Safety Requirement or other appropriate safety basis document. If the in-place leakage exceeds 0.03% or other specified value and cannot be adjusted by correcting the sealing clamps, the HEPA filter shall promptly be replaced.

5.0 Procurement Specifications

HEPA filters addressed by this local standard shall meet the specifications of DOE-STD-3020-97.